

THE MINERAL INDUSTRY OF MADAGASCAR

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The Republic of Madagascar, which is the world's fourth largest island, is located about 420 kilometers (km) east of Mozambique in the Indian Ocean. Madagascar had an area of 587,040 square kilometers (km²) and a population of more than 16 million in 2003. Its mining industry was chiefly noted for the production and export of chemical- and metallurgical-grade chromite ore, high-quality crystalline flake graphite, and precious, semiprecious, and ornamental gemstones. In addition to these minerals, small quantities of beryllium and gold and such industrial mineral commodities as cement, feldspar, ornamental stone, quartz, and salt were produced. Madagascar was also known to have resources of bauxite, coal, cobalt, copper, lead, manganese, nickel, platinum, tin, titanium, zinc, and zirconium.

In 2004, Madagascar's nominal gross domestic product (GDP) based on purchasing power parity amounted to about \$14.9 billion. Madagascar's real GDP increased by 5.3% in 2004 after rising by 9.8% in 2003. The manufacturing sector accounted for an estimated 13% of the nominal GDP; energy, 1%; and mining and construction materials, less than 1% (Ministère de l'Economie, des Finances et du Budget, 2004, p. 133; International Monetary Fund, 2005b, p. 208; 2005¹).

In 2004, real output in the mining sector was estimated to have grown at a rate of 7% after increasing by 10% in 2003 and decreasing by 34% in 2002. The construction materials sector grew by nearly 8% in 2004, and the energy sector, by 5% (Ministère de l'Economie, des Finances et du Budget, 2004, p. 130).

Commodity Review

Metals

Chromium.—The state-owned company Kraomita Malagasy (KRAOMA) produced chromite concentrates and lumpy ore from its mine at Ankazotaolana; the company exported to China, Japan, and Sweden. In 2004, chromite production increased to 77,386 metric tons (t) from 45,040 t in 2003 and 10,700 t in 2002 because of increased demand from China and increased political stability. KRAOMA planned to increase production to about 150,000 t in 2005, and exports, from 100,000 t to 130,000 t (Rampanjato, 2005a).

The company planned to restart production at the Bemanevoka Mine in 2006 because of the impending resource depletion at Ankazotaolana. The reopening of the Bemanevoka Mine, which shut down in 1968, has been delayed by technical difficulties in recent years. Reserves at Bemanevoka and Ankazotaolana were estimated to be 3 million metric tons (Mt) and 750,000 t, respectively. In 2004, exports of chromite were reported to be 84,918 t (Andrianatenaina, 2005b; L'Express de Madagascar, 2005; Rampanjato, 2005a).

Cobalt and Nickel.—Dynatec Corp. of Canada (53%) and Phelps Dodge Corp. of the United States (47%) were engaged in a joint venture to develop the Ambatovy nickel and cobalt deposit, which was expected to produce 60,000 metric tons per year (t/yr) of refined nickel and 5,000 t/yr of cobalt for more than 20 years. In addition to a mine, the project included the development of infrastructure, a power supply, and a metallurgical plant near Toamasina. The companies planned to complete their feasibility study at Ambatovy in the first quarter of 2005. If the feasibility study were to yield favorable results, then production could start in 2007. Resources at Ambatovy were estimated to be 210 Mt at grades of 1.1% nickel and 0.1% cobalt (Dynatec Corp., 2004a, b; Mining Journal, 2004).

In early 2004, Diamond Fields International Ltd. (DFI) of Canada engaged in exploration at the Valozoro nickel laterite deposit. Valozoro, which is located in south-central Madagascar, had resources of 3.7 Mt at a grade of 1.75% nickel. The company also engaged in exploration at its recently acquired Jango property, which is located northwest of Antananarivo (Diamond Fields International Ltd., 2004, 2005).

Copper and Platinum-Group Metals.—In 2004, Jubilee Platinum plc of the United Kingdom and its joint-venture partners explored for copper at Pachoud-Lanjanina, which had resources of 900,000 t at a grade of 1.9% copper. Jubilee planned further exploration work at Pachoud-Lanjanina to expand the resource. The company also explored at the Tsaratanana copper-nickel-platinum-group-metals property in the Londokomanana District. Jubilee held other exclusive license concessions that included the Ambodilafa copper-nickel property. It planned to convert its properties to 10-year exploration permits (Jubilee Platinum plc, 2004).

Gold.—Artisanal miners produced gold at numerous deposits in Madagascar, which include those at Ampanihy and Maevatanana in the east and Andavakoera in the northeast. Officially reported gold exports were only 5 kilograms (kg) in 2004. In July, Golden Deeps Ltd. of Australia acquired the Kelimaizina gold prospect in north-central Madagascar from Kalgoorlie Mine Management Pty. Ltd. Kalgoorlie engaged in exploration at Kelimaizina in November 2003. In November 2004, Pan African Mining Corp. of Canada began drilling at its Mountain of Gold property in the Dabolava region of the Central-West Plateau (Golden Deeps Ltd., 2004; Pan African Mining Corp., 2004; Rampanjato, 2005c).

Iron Ore.—Cline Mining Corp. of Canada acquired the Bekisopa iron ore property in 2004. The company had exclusive rights to conduct exploration, to complete a feasibility study, and to proceed to mining status. Resources at Bekisopa were estimated to be nearly 99 Mt at an average grade of 45% iron. Cline planned additional exploration work at Bekisopa to upgrade the resource (Cline Mining Corp., 2004).

¹A reference that includes a section mark (§) is found in the Internet Reference Cited section.

Titanium and Zirconium.—QIT Madagascar Minerals S.A. (QMM) [QIT Fer et Titane of Canada (a subsidiary of Rio Tinto plc), 80%, and the Government of Madagascar, 20%] planned to make an investment decision on its mineral sands project at Tolagnaro in southeastern Madagascar in 2005. If QMM were to proceed with the project, then production would be 700,000 t/yr of ilmenite and 33,000 t/yr of zircon at full capacity. The cost of the project, which included power, roads, and a new port near Tolagnaro, was estimated to be \$350 million. Resources at Tolagnaro were 67 Mt of ilmenite and 3 Mt of zircon (Mining Journal, 2004; Ministère de l'Énergie et des Mines, 2004).

Kumba Resources and Tigor Ltd. of Australia signed a joint-venture agreement to conduct a feasibility study on the Toliara mineral sands deposit. The companies planned to complete the study by the end of 2006. Kumba and Tigor had the option to purchase the interest of Madagascar Resources NL in Toliara after the completion of the study (African Mining, 2004).

Industrial Minerals

Cement.—Holcim (Madagascar) S.A. and SA Nouvelle Cimenterie Amboanio (66% owned by the Lafarge Group of France) operated two cement plants with capacities of 150,000 t/yr and 40,000 t/yr, respectively (table 2). In 2004, Madagascar's consumption of cement increased to nearly 500,000 t from 424,000 t in 2003. Higher consumption was attributable to such public works projects as schools and roads (Andrianatenaina, 2005a).

Diamond.—In October 2004, Majescor Resources Inc. of Canada formed a joint venture with the DeBeers Group to explore for diamond at the former company's properties in northern and central Madagascar. The companies planned joint exploration in late 2004 and 2005. DeBeers spent more than \$700,000 on diamond exploration in Madagascar in 2003 and 2004. DFI reduced its holdings on the Horombe Plateau to the area where kimberlitic ilmenites were found (Majescor Resources Inc., 2004; Diamond Fields International Ltd., 2005). Pan African Mining Corp. started diamond exploration in Madagascar in September.

Gemstones.—Madagascar was one of the world's leading producers of sapphire; most domestically mined sapphire was produced by artisanal miners at Ilakaka and Sakara in the south-central part of the country. Reported exports of sapphire fell to 5,890 kg in 2004 from 9,326 kg in 2002; the decrease was attributable to lower grades of sapphire at depths of 10 meters (m) at Ilakaka. Sapphire was discovered at depths of about 26 m, but mining at that depth would require the use of machinery unavailable to artisanal miners (Henricus, 2005; Rampanjato, 2005b).

MineCore International Inc. of the United States (known as Americana Gold and Diamond Holdings Inc. until July 2004) held the North Fork 14 sapphire concession at Ilakaka. The company planned to start mining sapphire and semiprecious gemstones in 2005; production could be nearly 3,000 kilograms per year (kg/yr) of sapphire and 1,400 kg/yr of semiprecious stones (Platinum Works Inc., 2001, p. 46; Americana Gold and Diamond Holdings Inc., 2003; MineCore International Inc., 2005).

Ruby was mined near Andilamena in north-central Madagascar and Vatomandry on the east coast. Reported exports of ruby fell to 741 kg in 2004 from 889 kg in 2002. The decrease in production was attributable to continued uncertainty about ownership of claims. Ruby mining reportedly led to environmental damage to the forest near Andilamena (Henricus, 2005; Rakotomalala, 2005; Rampanjato, 2005b).

Emerald was mined at Mananjary near the east coast. Reported exports of emerald rose to 53 kg in 2004 from 31 kg in 2002. The increase in production may be attributable to a new find of high-quality emerald (Henricus, 2005; Rampanjato, 2005b).

A new tourmaline-bearing pegmatite was discovered in the Antsirabe area. Production was sporadic because the deposit was in hard rock, and mining was conducted with hand tools. The supply of morganite, which is a type of beryl that obtains its pink color from inclusions of manganese, fell because of a cave-in at the most productive mine. Small amounts of aquamarine were produced (Henricus, 2005). In recent years, almandine, grossularite, pyrope-spessartine, rhodolite, and spessartine garnet have been mined in Madagascar.

Madagascar produced a wide range of ornamental stones that included agate, aragonite, jasper, labradorite, and rose quartz. Marbres et Granits de Madagascar (MAGRAMA) was the country's leading producer of labradorite. In 2003, MAGRAMA increased its production of labradorite to 3,500 t from 2,200 t in 2002; the company expected to increase production by 20% in 2004.

In 2004, the reported export value of ornamental, precious, and semiprecious stones amounted to \$17 million, or about 3% of total exports. Ornamental stones accounted for \$11.4 million; semiprecious gemstones, \$2.9 million; and precious gemstones, \$2.7 million (Ministère de l'Économie, des Finances et du Budget, 2004, p. 139; Rampanjato, 2005c).

The low value of Madagascar's reported gemstone exports was attributable to the lack of a significant domestic lapidary industry and high rates of smuggling. Reported exports of cut gemstones amounted to only 2 kg in 2004; most semiprecious and ornamental stones were exported in rough form. In early 2004, cutting and polishing facilities employed about 1,000 workers, about 80% of whom were involved in cutting such ornamental stones as agate and labradorite. Most of the cutting and polishing facilities were located in Antananarivo or near individual mines (Moscato, 2004; Rampanjato, 2005c).

Illegal exports of sapphire to Thailand were estimated to be about 2,600 kg/yr, and those to other countries, about 500 kg/yr. The value of undeclared gemstone exports was estimated to be \$100 million. The World Bank Group planned to increase Madagascar's reported gemstone exports to between \$40 million and \$80 million per year mostly by expanding the domestic lapidary industry (Moscato, 2004; Gazette de la Grande Ile, 2005; Mercia, 2005).

Graphite.—The leading producer of graphite was Etablissements Gallois, which had mines at Ambalafotaka, Antsirakambo, and Marovintsy on the east coast. The company produced about 10,000 t/yr of graphite. Etablissement Izouard, Etablissement Rostaing, Société Louys, and Société Minière de la Grande Ile also mined graphite. In 2004, exports of graphite were estimated to be 14,000 t at a value of \$5.2 million, or 1% of total exports (Ministère de l'Économie, des Finances et du Budget, 2004, p. 139).

Mineral Fuels

Petroleum.—Galana Petroleum Ltd. of Mauritius managed Madagascar's only petroleum products refinery at Toamasina. The company produced about 1.4 million barrels per year of residual fuel oil, of which 15% was consumed locally and 85% was exported. In November, the Government announced that it was opening a civil case against Galana for allegedly polluting the air and water near the refinery. The company denied the charges. In 2004, national imports of petroleum products amounted to \$158.5 million, or 15% of total imports (Ministère de l'Economie, des Finances et du Budget, 2004, p. 140; Reuters, 2004).

In August 2004, Exxon Mobil Corp. purchased 40% of the Majunga Offshore concession, which was located to the northwest of Madagascar. Vanco Energy Company and Norsk Hyrdo ASA each held a 30% interest in the Manjunga Offshore concession. In late December, ExxonMobil signed a contract for an exploration license that covered 36,500 km² off Cape St. Andre. Sterling Energy held the Ambilobe and the Ampasindva licenses, which were located to the north of the Majunga Offshore. Madagascar Oil (a subsidiary of Vuna Capital of the United Kingdom) held an exploration license for the bituminous sands at Tsimiroro and bituminous clay at Bemolanga (Africa Energy Intelligence, 2005).

Infrastructure

Jiro Sy Rano Malagasy (JIRAMA) was the Government-owned utility that produced most of Madagascar's electricity. By November, Compagnie Generale d'Electricite of France and Lahmeyer International of Germany had submitted bids to take over management of JIRAMA.

In 2004, Madagascar produced 983.6 gigawatthours (GWh) of electricity compared with 893.6 GWh in 2003 and 721.3 GWh in 1999. Hydroelectric power sources provided 65% of the country's electricity, and fossil fuel sources accounted for the remaining 35%. National consumption of electricity was 755.6 GWh compared with 675.5 GWh in 2003 and 571.5 GWh in 1999 (International Monetary Fund, 2005a, p. 94).

Madagascar had a road network of 33,000 km and a rail network of 800 km. The road and rail networks have deteriorated during the past 10 years; the Government planned to rehabilitate 14,000 km of roads. The country also had 6 international and 12 local ports; the most important international port was Toamasina (Ministère de l'Energie et des Mines, 2004).

Outlook

The International Monetary Fund (2005b, p. 208) predicted that Madagascar's GDP would rise by 6.4% in 2005 and 7% in 2006. High rates of GDP growth may lead to increased domestic demand for such local construction materials as cement, gravel, limestone, and sand. Madagascar's beryl, chromite, gemstone, gold, graphite, and mica industries depended heavily upon world market conditions and political stability; the same held true for such undeveloped mineral commodities as nickel, titanium, and zirconium. The World Bank Group (2003, p. 41) estimated that development of the Ambatovy nickel project would result in exports of \$185 million per year, and the Tolagnaro mineral sands project, \$80 million per year.

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TABLE 1
MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES¹

(Kilograms unless otherwise specified)

| Commodity ² | 2000 | 2001 | 2002 | 2003 ^e | 2004 ^e |
|---|---------------------|---------------------|------------------------|---------------------|---------------------|
| METALS | | | | | |
| Beryllium, beryl in quartz concentrates, industrial and ornamental ^f | 1,696 ³ | 1,000 | 1,000 | 1,000 | 1,000 |
| Chromium, marketable output: | | | | | |
| Chromite concentrate, gross weight metric tons | 24,922 | 6,599 | 2,700 ^{r, e} | 12,000 | 21,000 |
| Chromite ore, lumpy do. | 106,371 | 17,038 | 8,000 ^e | 33,000 | 56,000 |
| Total do. | 131,293 | 23,637 | 10,700 ^r | 45,040 ³ | 77,386 ³ |
| Gold, mine output, Au content ⁴ | 5 | (5) | -- ^{r, e} | 10 ³ | 5 ⁶ |
| INDUSTRIAL MINERALS | | | | | |
| Abrasives, natural (industrial only) ^e | 1,300 | 1,300 | 1,300 | 1,300 | 1,300 |
| Cement, hydraulic metric tons | 50,938 | 51,882 | 33,000 ^{r, e} | 70,000 ^r | 110,000 |
| Clay, kaolin ^e do. | 170 | 170 | 170 | 170 | 170 |
| Feldspar ^e do. | 7 ^{r, 3} | 3 ^r | 3 ^r | 3 ^r | 3 |
| Gemstones:^{6, 7} | | | | | |
| Amethyst ⁸ | 1,070 ^r | 383 ^r | 617 ^r | 620 ^r | 620 |
| Cordierite | 625 | 4,241 | 158 | 160 | 160 |
| Emerald | 11 ^r | (5) ^r | 31 ^r | 40 ^r | 53 ⁶ |
| Garnet | 324 | 2,092 | 599 | 600 | 600 |
| Ruby | 8 ^r | 941 | 889 ^r | 800 ^r | 741 ⁶ |
| Sapphire | 9,536 | 8,470 | 9,326 ^r | 6,000 | 5,890 ⁶ |
| Tourmaline ⁸ | 40,353 ^r | 78,971 ^r | 63,722 ^r | 64,000 ^r | 64,000 |
| Graphite, all grades: metric tons | 40,328 | 2,013 | 2,000 ^{r, e} | 15,000 ^r | 15,000 |
| Mica, phlogopite do. | 66 | 90 | 90 ^e | 90 | 90 |
| Ornamental stones:⁷ | | | | | |
| Agate ^e | 49,675 ³ | 25,000 | 20,000 ^r | 25,000 ^r | 25,000 |
| Labradorite metric tons | 629 | 797 | 4,183 | 6,600 | 8,000 |
| Quartz ^{6, 9} do. | 1,978 | 574 | 423 | 430 | 430 |
| Salt, marine do. | 25,530 | 25,928 | 17,000 | 26,000 | 26,000 |
| Stone: | | | | | |
| Dimension ^e do. | 200 | 200 | 200 | 200 | 200 |
| Marble do. | 1,222 | 5,600 | 5,600 ^e | 5,000 | 5,000 |
| MINERAL FUELS AND RELATED MATERIALS | | | | | |
| Petroleum refinery products: | | | | | |
| Gasoline thousand 42-gallon barrels | 571 ^r | 488 ^r | 237 ^r | 500 ^r | 500 |
| Kerosene and jet fuel do. | 418 ^r | 332 ^r | 163 ^r | 350 ^r | 350 |
| Distillate fuel oil do. | 683 ^r | 600 ^r | 357 ^r | 750 ^r | 750 |
| Residual fuel oil do. | 1,208 ^r | 578 ^r | 317 ^r | 670 ^r | 670 |
| Liquefied petroleum gas do. | 46 ^r | 41 ^r | 14 ^r | 30 ^r | 30 |
| Total do. | 2,926 ^r | 2,039 ^r | 1,088 ^r | 2,300 ^r | 2,300 |

^eEstimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. ^rRevised. -- Zero.

¹Includes data available through September 30, 2005.

²In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (other clays, sand and gravel, and stone) and industrial calcite presumably were produced, but output was not reported quantitatively, and available information was inadequate to make reliable estimates of output levels.

³Reported figure.

⁴Does not include smuggled artisanal production, which was estimated to be from 1,000 to 2,000 kilograms per year.

⁵Less than 1/2 unit.

⁶Reported exports.

⁷Does not include smuggled artisanal production.

⁸Includes both gem- and ornamental-quality.

⁹Quartz production included 6 metric tons of rose quartz in 2000 and 11 metric tons in 2001.

TABLE 2
MADAGASCAR: STRUCTURE OF THE MINERAL INDUSTRY IN 2004

(Metric tons unless otherwise specified)

| Commodity | | Major operating companies | | Location of main facilities | Annual capacity |
|--------------------|----------------------------|---|--|--|-------------------------------------|
| Cement | | Holcim (Madagascar) S.A. (Holcim Group, 90%) | | Plant at Ibity | 150,000 cement; 120,000 clinker. |
| Do. | | SA Nouvelle Cimenterie Amboanio (LaFarge Group, 66%, and Moustansir Ibaramdy Family, 34%) | | Plant at Mahajanga | 40,000 cement; 40,000 clinker. |
| Chromium | | Kraomita Malagasy (Government, 100%) | | Mine at Ankazotaolana | 250,000 run of mine. |
| Do. | | do. | | Mine at Bemanekiva | 40,000 run of mine. |
| Gemstones: | | | | | |
| Emerald | kilograms | Artisanal and small-scale miners | | Mines at Mananjary | 55. ^c |
| Labradorite | | Marbres et Granits de Madagascar | | Mines at Ambatofinandrahana and Bekily | 4,200. ^c |
| Ruby | do. | do. | | Mines at Andilamena and Vatomandry | 1,000. ^c |
| Sapphire | | do. | | Mines at Ilakaka and Sakara | 10,000. ^c |
| Graphite | | Etablissements Gallois | | Artsirakambo Mine near Brickaville | 4,800. |
| Do. | | do. | | Marovinsty Mine near Vatomandry | 3,600. |
| Do. | | do. | | Ambalafotaka Mine | NA. |
| Do. | | Société Minière de la Grande Ile | | Ambatomitamba Mine near Tamatave | 6,000. |
| Do. | | Etablissements Izouard | | Faliarno Mine near Moramanga | 2,000. |
| Do. | | Etablissements Rostaing and Société Louys | | NA | NA. |
| Mica | | Societe des Mines d'Ampandranhava | | Tolagnaro | 2,000 processed. |
| Petroleum, refined | thousand 42-gallon barrels | Galana International, Groupe Trimeta, Gulf Oil Corporation, and Petroleum India International | | Refinery at Toamasina | 5,475. |

^cEstimated. NA Not available.